

We push the frontiers of computing science in modeling, data storage, and high-speed networks

Mission The Computation Directorate provides state-of-the-art computer technology and services to all Livermore research projects. We are a resource of cutting-edge expertise in computers and computing science. We engage in applied research activities that advance our capabilities in computational science and support Livermore's national-security and other missions.

**Computations
Integral to
All Research** At the inception of the national laboratory system, the compelling need for numerical simulation of nuclear explosions drove the development of the high-performance computer industry and set many of the standards for scientific computing. The ability to design nuclear weapons with only a few nuclear tests— and now to ensure the safety and reliability of the enduring U.S. stockpile without nuclear testing— is made possible by advances in our computational modeling capabilities.

Many major breakthroughs in science and technology have their origins in the weapons laboratories' expertise in modeling and simulation. Progress toward inertial confinement fusion as a practical energy source involves a closely linked modeling and experimental effort. The design of modern lasers, particle accelerators, or large experimental detectors is virtually unthinkable without extensive modeling expertise.

The Computation Directorate continues to contribute to Livermore's science and technology products through a broad array of multidisciplinary research projects sponsored by the Department of Energy, other government agencies, and industrial partners. Current projects include:

- Development and application of adaptive mesh refinement algorithms to computational fluid dynamics, vital to our national-security mission and many other related programs.
- Image processing for medical and industrial applications.
- Computational biomechanics.
- Active computer vision applications in motion detection and analysis.
- Advances in state-of-the-art high-performance data storage and data management systems.
- Development of advanced application codes for large-scale parallel processing systems.
- Climate system modeling on massively parallel systems.

- Implicit and explicit finite-element algorithms for massively parallel computers with applications in solid and structural mechanics.
- Three-dimensional simulation of plasmas and other complex phenomena important to our national-security mission.
- Applied electromagnetic simulation on parallel computers.

Recent Accomplishments

- Leader in the multilaboratory Accelerated Strategic Computing Initiative (ASCI) that will provide the computational underpinnings for science-based stockpile stewardship.
- Participation in the Industrial Computing Initiative to bring parallel computing to maturity; because massively parallel processing is an essential capability for stockpile stewardship, this partnership with U.S. industry directly contributes to our national-security mission.
- Development of new adaptive algorithms for the noninvasive monitoring of blood oxygen saturation of patients in real time.
- Completion of a nine-year effort to define, test, and promote the international CALS digital data interchange standards, which have been adopted in the U.S., Canada, Great Britain, Australia, and France.

Benefits to the Nation

Livermore is renowned for its ability to apply computer modeling and simulation to solve large, complex, multidisciplinary scientific and engineering problems. Success in achieving our national-security and related missions depends increasingly on the enabling technologies of scientific computing, high-speed communications, and large-scale information storage and retrieval.

The Computation Directorate is responsible for managing and operating two of the most powerful supercomputing centers in the world, one dedicated to defense-related applications and the other to national energy research. We also manage and operate the Energy Sciences Network (that portion of the Internet managed by the Department of Energy). High-speed networks enable unprecedented sharing of resources, including remote control of physical experiments and long-distance scientific collaborations. Equally important, we conduct independent and collaborative research in computing science that supports Livermore's multidisciplinary programs and enhances our core scientific and technical capabilities.

Contact

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